TITLE OF THE INVENTION

PRINTING APPARATUS AND PRINTING SYSTEM

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FIELD OF THE INVENTION

This invention relates to a printing apparatus and printing system and, more particularly, to a printing apparatus which comprises an inkjet printhead, and a printing system using that printing apparatus.

BACKGROUND OF THE INVENTION

Conventionally, a printer apparatus which comprises a non-volatile memory such as an EEPROM, flash memory, or the like, that stores individual information such as the operation state, operation history, production number, device ID, and the like of a printhead used in that printer apparatus, and control information such as print position correction information of a head carriage upon reciprocal printing and the like, is known.

For example, Japanese Patent Publication Laid-Open No. 5-309839 discloses a printer apparatus which stores information used to correct a mount error of a printhead, Japanese Patent Publication Laid-Open No. 8-224890 discloses a printer apparatus which stores time information elapsed after the previous recovery

operation of a printhead, and Japanese Patent

Publication Laid-Open No. 2000-35922 discloses a

printer apparatus which stores control information of

an ink residual amount, head cleaning time, the

5   position of a printhead, a roll paper residual amount,

and the like.

Also, Japanese Patent Publication Laid-Open

No. 10-278360 discloses a printer apparatus in which a

printhead unit comprises an EEPROM, and stores

10   information such as the operation characteristics and

the like of that printhead.

In case of a printer apparatus in which a

printhead is not detachable from a printer apparatus

main body and the printhead need not or cannot be

15   exchanged, all of control information, characteristic

information of the printhead, and the like can be

stored in a single non-volatile memory together as in

the above prior art. In this case, the physical mount

position of the non-volatile memory can be either on

20   the printer main body side or printhead side, as long

as they can exchange information.

However, in a case where a printhead is

detachable from a printer apparatus or various types of

printheads can be exchangeably and selectively attached

25   to satisfy various user's purposes, characteristic

information unique to a given printhead cannot be

pre-stored in a non-volatile memory of the printer

apparatus side, and control information or the like of
the printer apparatus side cannot be stored in all
non-volatile memories of individual printheads.

In such case, both the printer apparatus and
5 printhead comprise non-volatile memories such as
EEPROMs or the like to respectively hold necessary
information.

However, such memories increase the cost of the
overall printer apparatus accordingly. In case of a
10 disposal type of printhead, a non-volatile memory is
also disposed every time the printhead is exchanged.
This is not economical. Furthermore, even in case of a
printhead which is not of disposal type but can be
repetitively used by exchanging or refilling only ink
15 (or an ink tank), since the life time of the printhead
is normally much shorter than that of the printer
apparatus main body, the printhead must be exchanged
several times during the life time of the printer main
body. This is also not economical like the case of
20 using the disposal type of printhead.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present
25 invention to provide a low-cost, economical printing
apparatus and printing system, in which only a printing
apparatus main body comprises a non-volatile memory,

which has been conventionally provided to both the printing apparatus main body and printhead, so as to unifiedly manage control information, characteristic information of a printhead, and the like.

5   According to one aspect of the present invention, the foregoing object is attained by providing a printing apparatus for printing on a printing medium using a printhead, comprising: an interface which is connected to a host and receives information from the

10   host; a non-volatile memory for storing characteristic information of the printhead; discriminating means for discriminating whether or not a command sent from the host is a command including the characteristic information of the printhead; write control means for

15   controlling to write the characteristic information of the printhead into the non-volatile memory in accordance with a discrimination result of the discriminating means; and printing control means for controlling the printhead to print in accordance with

20   the characteristic information written into the non-volatile memory.

Note that the characteristic information preferably includes type information of the printhead, and the write control means controls to write the

25   characteristic information of the printhead for each type of printhead.

- 4 -

The printhead is detachable from a printing apparatus main body, and a user can selectively attach a desired one of a plurality of types of printheads to the printing apparatus.

5   The discriminating means preferably includes means for receiving a command outputted from the host to which the characteristic information of the printhead indicated on the printhead or an accessory of the printhead in a format identifiable to human or an

10   electronic device is inputted by man-machine interactive operation or the electronic device.

The printhead is an inkjet printhead for printing by discharging ink, and the inkjet printhead preferably comprises an electrothermal transducer for generating

15   heat energy to be given to ink so as to discharge ink by utilizing the heat energy.

Furthermore, the non-volatile memory includes an EEPROM.

According to one aspect of the present invention,

20   the foregoing object is attained by providing a printing system including the above-described printing apparatus, and a host connecting to the printing apparatus and capable of communicating with a second system via a network, the host comprising: input means

25   for inputting individual information of a printhead indicated on the printhead or an accessory of the printhead in a format identifiable to human or an

electronic device via man-machine interactive operation
or the electronic device; retrieve means for accessing
to the second system via the network on the basis of
the individual information of the printhead inputted by

5   the input means, and retrieving characteristic
information of the printhead corresponding to the
individual information of the printhead; and transfer
means for transferring the characteristic information
of the printhead retrieved by the retrieve means to the

10   printing apparatus.

Note that the network includes a LAN or Internet,
and the individual information of the print head can be
a production number of the printhead.

The second system has a database in which

15   information is retrievable via the network, and the
database holds characteristic information of the
printhead corresponding to the individual information
of the printhead.

Note that the format identifiable to human is at

20   least one of a digit and a character string, and the
format identifiable to the electronic device is a
barcode.

In a case where the characteristic information of
the printhead is input by the man-machine interactive

25   operation, at least one of a digit and a character
string is preferably input to the host. In a case
where the characteristic information is input from the

electronic device, a barcode is preferably read by a barcode reader.

In accordance with the present invention as described above, the characteristic information of a printhead indicated on the printhead or its accessory in a format identifiable to human or an electronic device is input to a host by man-machine interactive operation or electronically by the electronic device. The printing apparatus discriminates whether or not a command sent from the host via an interface contains the characteristic information of the printhead, controls to write the characteristic information of the printhead in a non-volatile memory in accordance with the discriminating result, and controls the printhead to print.

The invention is particularly advantageous since a non-volatile memory for storing characteristic information is no longer required for a printhead unlike in the conventional apparatus.

In this way, a low-cost, economical printhead and printing apparatus can be provided.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated
5   in and constitute a part of the specification,
illustrate embodiments of the invention and, together
with the description, serve to explain the principles
of the invention.

Fig. 1 is a perspective view showing the outer
10   appearance of an inkjet printer IJRA as a
representative embodiment of the present invention;

Fig. 2 is a block diagram showing the arrangement
of a control circuit of the inkjet printer;

Fig. 3 is a perspective view showing the outer
15   appearance of the structure of an inkjet cartridge IJC
in which an ink tank and printhead are separable;

Fig. 4 is a perspective view showing the outer
appearance of a packaging paper box on which the
characteristic information of a printhead is printed;

20   Fig. 5 is a flow chart showing the process for
identifying the type of printhead and inputting the
characteristic information of the printhead;

Fig. 6 is a perspective view showing a packaging
plastic box to which a seal on which a barcode obtained
25   by converting the characteristic information of the
printhead is printed is adhered;

Fig. 7 is a schematic block diagram showing an overview of a production line system in a factory for inputting the characteristic information of a printhead to a printer;

5 Fig. 8 is a perspective view showing the outer appearance of a packaging paper box on which the characteristic information of a printhead is printed; and

Fig. 9 is a schematic block diagram showing a
10 system that downloads the characteristic information of a printhead via the Internet.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

<Brief Description of Apparatus Main Unit>

Fig. 1 is a perspective view showing the outer
20 appearance of an ink-jet printer 20 (hereinafter referred to as a printer) as a typical embodiment of the present invention. Referring to Fig. 1, a carriage HC engages with a spiral groove 5004 of a lead screw 5005, which rotates via driving force transmission
25 gears 5009 to 5011 upon forward/reverse rotation of a driving motor 5013. The carriage HC has a pin (not shown), and is reciprocally scanned in the directions

- 9 -

of arrows a and b in Fig. 1. An integrated ink-jet cartridge IJC which incorporates a printhead IJH and an ink tank IT is mounted on the carriage HC. Reference numeral 5002 denotes a sheet pressing plate, which presses a paper sheet against a platen 5000, ranging from one end to the other end of the scanning path of the carriage. Reference numerals 5007 and 5008 denote photocouplers which serve as a home position detector for recognizing the presence of a lever 5006 of the carriage in a corresponding region, and used for switching, e.g., the rotating direction of the motor 5013. Reference numeral 5016 denotes a member for supporting a cap member 5022, which caps the front surface of the printing head IJH; and 5015, a suction device for sucking ink residue through the interior of the cap member. The suction device 5015 performs suction recovery of the printing head via an opening 5023 of the cap member 5015. Reference numeral 5017 denotes a cleaning blade; 5019, a member which allows the blade to be movable in the back-and-forth direction of the blade. These members are supported on a main unit support plate 5018. The shape of the blade is not limited to this, but a known cleaning blade can be used in this embodiment. Reference numeral 5021 denotes a lever for initiating a suction operation in the suction recovery operation. The lever 5021 moves upon movement of a cam 5020, which engages with the carriage, and

receives a driving force from the driving motor via a known transmission mechanism such as clutch switching.

The capping, cleaning, and suction recovery operations are performed at their corresponding positions upon operation of the lead screw 5005 when the carriage reaches the home-position side region. However, the present invention is not limited to this arrangement as long as desired operations are performed at known timings.

<Description of control construction>

Next, a control construction for performing a printing control in the above apparatus will be described.

Fig. 2 is a block diagram showing the arrangement of a control circuit of the printer 20. Referring to Fig. 2 showing the control circuit, reference numeral 1700 denotes an USB interface for inputting a printing signal from a personal computer 21 (hereinafter referred to as a host); 1701, an MPU; 1702, a programmable ROM for storing a control program executed by the MPU 1701 and necessary control data; and 1703, a DRAM for storing various data (the printing signal, printing data supplied to the printhead IJH, and the like). Reference numeral 1704 denotes a gate array (G.A.) for performing supply control of printing data to the printhead IJH. The gate array 1704 also performs data transfer control among the interface 1700,

the MPU 1701, and the RAM 1703. Reference numeral 1710 denotes a carrier motor for carrying the printhead IJH; and 1709, a conveyance motor for conveying a printing medium (e.g. a printing sheet). Reference numeral 1705

5   denotes a head driver for driving the printhead IJH; and 1706 and 1707, motor drivers for driving the conveyance motor 1709 and the carrier motor 1710.

Reference numeral 1708 denotes an EEPROM used to store the characteristic information of a printhead in

10 addition to the production number, operation state, various kinds of correction information, and the like of the printer.

The operation of the above control arrangement will be explained next. When print data is input to

15 the interface 1700, it is converted into a print signal between the gate array 1704 and MPU 1701. The motor drivers 1706 and 1707 are driven, and the printhead IJH is driven in accordance with print data sent to the head driver 1705, thus printing.

20 Note that an ink tank IT and the printhead IJH may be integrally formed to constitute an exchangeable ink cartridge IJC, as described above. Also, the ink tank IT and the printhead IJH may be separably arranged, and the ink tank IT alone may be exchanged when ink is

25 exhausted.

In place of the USB interface 1700, interfaces of other standards, e.g., a Centronics or IEEE1284 interface may be used.

Fig. 3 is a perspective view showing the
5   structure of an ink cartridge IJC in which an ink tank and printhead are separable. As shown in Fig. 3, in the ink cartridge IJC, an ink tank IT and printhead IJH are separable at the position of a boundary line K. The ink cartridge IJC has electrodes (not shown) for
10   receiving an electrical signal supplied from the carriage HC when it is mounted on a carriage HC. This electrical signal drives printing elements of the printhead IJH to discharge ink, as described above.

Note that reference numeral 500 in Fig. 3 denotes
15   an ink discharge port array. The ink tank IT has a fibrous or porous ink absorber for holding ink, and the ink absorber holds ink.

As the printhead IJH detachable from the printer apparatus used in this embodiment, a plurality of types
20   of printheads are available: for example, a monochrome printhead, color printhead, photo-quality printhead, and the like. A user can selectively attach an optimal one of these printheads according to the user's need. Each of these printheads has a signal terminal which
25   can output a 2-bit signal regardless of their types. When a printhead is mounted on the printer 20, it outputs a 2-bit ON/OFF signal, so that the printer 20

can identify the type of currently mounted printhead. In this arrangement, up to four different printhead types can be identified.

Note that the signal terminal for outputting a 2-bit signal used to identify the printhead type may be a dedicated terminal, but it may be commonly used as another signal terminal since that identification process is not always executed during the print process.

With this arrangement, the printer 20 of this embodiment receives print data from the host 21 via the USB interface 1700, generates a signal to be transferred to the printhead IJH based on the received information, and transfers the generated signal to the printhead IJH to control it to discharge ink onto a printing medium (e.g., a printing sheet), thus attaining a desired print process.

The host 21 and printer 20 exchange various commands and corresponding status values via the USB interface 1700, in addition to print data. These command status values include a write instruction of the characteristic information of the printhead IJH into the EEPROM 1708, in addition to confirmation of the operation state, confirmation of the presence/absence of errors, a head cleaning instruction, an ON/OFF instruction of the power supply of the printer 20, and the like. Whether data sent from the host 21 is print data or a command, and the type of

command if the data is a command can be identified based on a header appended to the header of that transferred data.

Fig. 4 is a perspective view showing the outer appearance of a packaging paper box, which is an accompanying material with the printhead, for packing the printhead IJH.

As shown in Fig. 4, the characteristic information of the printhead or information related to the characteristic information which is converted into a hexadecimal character string code is indicated (printed) on the side surface of a packaging paper box 25 upon shipping. The information is appended with type information of a printhead and check sum information for error detection, and information of a total of 64 bits, which include: 52 bits for exact characteristic information such as the correction value of an ink discharge amount, the resistance of a heater for ink discharge, fluctuation correction value for each nozzle, and the like, or information related to the exact characteristic information; 4 bits for type information; and 8 bits for a check sum, is converted into an 8-digit, hexadecimal code.

The process for identifying the type of printhead and inputting the characteristic information of the printhead of this embodiment will be described in

detail below with reference to the flow chart shown in
Fig. 5.

In step S100, the control waits for data received
from the host 21. Upon detecting data reception, the
flow advances to step S101 to check if the received
data is print information or a command.

If it is determined that the received data is
print information, the flow advances to step S102, and
the printhead is driven using the characteristic
information corresponding to the type of currently
mounted printhead on the basis of the characteristic
information currently stored in the EEPROM 1708, thus
making a print process. After that, the flow returns
to step S100. On the other hand, if it is determined
that the received data is a command, the flow advances
to step S103.

It is discriminated in step S103 if the command
is a write instruction command of the characteristic
information of a printhead into the EEPROM 1708 or
another command. If it is discriminated that the
received command is a command other than the write
instruction of the characteristic information of a
printhead, the flow advances to step S104 to execute a
process corresponding to that received command. After
that, the flow returns to step S100.

If the received command is the write instruction
of the characteristic information of a printhead into

the EEPROM 1708, the flow advances to step S105 to

confirm a check sum. If it is confirmed that the

instruction is effective, the flow advances to step

S106 to extract the type information of the printhead.

5   Furthermore, the characteristic information of the

printhead of that type, which is stored in the EEPROM

1708 is rewritten by the characteristic information

received from the host 21 in step S107.

The flow then returns to step S100 to wait for

10   the next data.

The way of how the characteristic information and

the type of printhead are transferred to the printer 20

upon receiving from the host 21 the write instruction

command of the characteristic information of the

15   printhead into the EEPROM 1708 will be explained below.

When a user who has purchased the printer

apparatus attaches a printhead for the first time, when

a user who has purchased a commercially available

optional printhead attaches that printhead for the

20   first time, or when the life time of a printhead has

expired and a user exchanges that printhead with a

separately purchased one, he or she activates utility

software (which is attached to the printer apparatus in

the form of a CD-ROM or the like together with driver

25   software and the like upon shipping from a factory) on

the host 21, and inputs the characteristic information

of the printhead printed on the packaging paper box 25

at a keyboard or the like of the host 21 in accordance
with an instruction on the window displayed on a
display (LCD, CRT, PDP, or the like) of the host 21
upon executing that software.

5   Note that this software need not be a standalone
program, but may be activated as one of setup menus
upon executing driver software.

       The characteristic information which is input in
accordance with the instruction from the utility
10   software which runs on the host 21 is set as an operand
of a command that indicates a write instruction of the
characteristic information of the printhead in the
EEPROM 1708, and is sent to the printer 20 together
with that command. In this way, the information is
15   finally written into the EEPROM 1708.

       Once the characteristic information is written
into the EEPROM 1708, a print process is performed
using that characteristic information. Since the
characteristic information of the printhead is written
20   for each type of printhead, it need only be written
once when the printhead is attached to the printer for
the first time. Hence, the user need not write the
characteristic information every time he or she
exchanges the printhead by another type of printhead
25   according to his or her purpose (e.g., the user
exchanges a monochrome printhead by a color printhead).

Therefore, according to the aforementioned embodiment, the characteristic information of a printhead is printed as a character code on the packaging paper box of that printhead, and the user

5   reads and inputs that code via the keyboard. The host to which the printer is connected sends that code via the printer interface to write it into the EEPROM of the printer. In this manner, an EEPROM conventionally required in the printhead is no longer necessary.

10   In the above embodiment, the EEPROM is used as a non-volatile memory. However, the present invention is not limited to such a specific memory. For example, other non-volatile memories such as a flash memory and the like may be used.

15   The characteristic information of the printhead is not only printed as a character code on the packaging paper box which is an accompanying material, but also directly printed, impressed or engraved on the side surface or the like of the printhead.

20   Alternatively, the characteristic information may be printed or stamped on an accompanying material including a paper sheet such as a manual, warranty, or the like included in a package, or may be printed, impressed, or engraved on another accompanying material

25   including an anti-dry packaging or wrapping material that wraps the printhead upon shipping.

[Another Embodiment]

- 19 -

In the above embodiment, the present invention is applied to a case wherein a user writes the characteristic information of the printhead into the EEPROM of the printer. Also, the present invention can be applied to the production line of a factory.

Fig. 6 shows a packaging plastic box 26, which wraps a printhead, the top portion of which is covered by an openable film sealed by, e.g., heat welding or the like. A barcode seal 27 printed with a barcode, which is obtained by converting the characteristic information of a printhead, is adhered in advance to the side surface of the packaging plastic box 26 during production process of the printhead.

On the other hand, Fig. 7 is a schematic block diagram showing an overview of a production line system of a factory that implements this embodiment.

Referring to Fig. 7, reference numeral 20 denotes a printer described in the above embodiment (no printhead is mounted since it is still on the production line in the factory); and 22, an implementation tool having the same USB interface as the USB interface 1700 of the printer 20. The implementation tool 22 is used to send the characteristic information of the printhead to the printer 20 as a command. As can be seen from Fig. 7, a barcode reader 23 is connected to the implementation tool 22.

In the production line system with the above arrangement, the barcode seal 27 adhered on the side surface of the packaging plastic box 26 that stores a printhead is read using the barcode reader 23, and the

5   read characteristic information is sent to the printer 20 using the implementation tool 22 and is written into the EEPROM 1708. After that, the printer 20 and packaging plastic box 26 can be shipped together in a single package.

10   In the above description, the characteristic information of the printhead is converted into a barcode to be indicated. However, the present invention is not limited to this. For example, the characteristic information of the printhead may be

15   printed in an electrically, magnetically or optically readable format such as magnetic recording, OCR, or the like other than the barcode. In such case, an implementation tool that comprises a corresponding reader is used.

20   Therefore, according to the aforementioned embodiment, in the production line of a factory in which packaging plastic boxes that store printheads and printers are packed and shipped in a large quantity in a short period of time, the characteristic information

25   of a printhead to be packed can be efficiently read and written into the EEPROM of the corresponding printer.

In this way, since the characteristic information of the printhead has already been written in the EEPROM of the printer packed together with that printhead upon shipping from the factory, the need for writing

5   characteristic information of the printhead can be obviated when a user who has purchased the printer attaches the printhead for the first time unlike in the above embodiment.

In the aforementioned embodiments, the

10   characteristic information itself of the printhead is printed on the packaging paper box or packaging plastic box.

However, the characteristic information itself need not always be printed. For example, as shown in

15   Fig. 8, a unique number (individual number) such as the production number or the like of a printhead may be printed on the packaging paper box 25 of the printhead, and the characteristic information of the printhead may be retrieved from a database via a network on the basis

20   of the unique number.

For example, when the host 21 to which the printer 20 is connected is connected to the Internet, as shown in Fig. 9, the host 21 is set to be capable of accessing, via the Internet, a database 31 built in a

25   server 30 provided by the manufacturer of the printer and printhead, and the database 31 accumulates characteristic information of all shipped printheads,

so that characteristic information of a printhead can
be retrieved based on the production number of the
printhead. Then, the user can obtain the
characteristic information corresponding to the
5   production number of his or her printhead. In this way,
the retrieved characteristic information of the
printhead is sent from the host 21 to the printer 20,
and is finally written into the EEPROM 1708.

In this case, it goes without saying that an
10   Internet communication program used to access the
database 31 and an access program to the database 31
have been already installed in the host 21, and these
programs are ready to run.

In the example shown in Fig. 9, the
15   characteristic information of the printhead is remotely
acquired via the Internet. If the Internet is replaced
by a LAN, and the host 21 is replaced by the
implementation tool 22, this method can be used in the
production line of the factory.

20   Note that in the above embodiments, the liquid
discharged from the printhead has been described as ink,
and the liquid contained in the ink tank has been
described as ink. However, the liquid is not limited
to ink. For example, the ink tank may contain
25   processed liquid or the like discharged to a print
medium to improve fixability or water repellency of a
printed image or to increase the image quality.

The embodiments described above have exemplified a printer, which comprises means (e.g., an electrothermal transducer, laser beam generator, and the like) for generating heat energy as energy utilized

5   upon execution of ink discharge, and causes a change in state of an ink by the heat energy, among the ink-jet printers. According to this ink-jet printer and printing method, a high-density, high-precision printing operation can be attained.

10   As the typical arrangement and principle of the ink-jet printing system, one practiced by use of the basic principle disclosed in, for example, U.S. Patent Nos. 4,723,129 and 4,740,796 is preferable. The above system is applicable to either one of the so-called on-

15   demand type or a continuous type. Particularly, in the case of the on-demand type, the system is effective because, by applying at least one driving signal, which corresponds to printing information and gives a rapid temperature rise exceeding nucleate boiling, to each of

20   electrothermal transducers arranged in correspondence with a sheet or liquid channels holding a liquid (ink), heat energy is generated by the electrothermal transducer to effect film boiling on the heat acting surface of the printhead, and consequently, a bubble

25   can be formed in the liquid (ink) in one-to-one correspondence with the driving signal. By discharging the liquid (ink) through a discharge opening by growth

and shrinkage of the bubble, at least one droplet is formed. If the driving signal is applied as a pulse signal, the growth and shrinkage of the bubble can be attained instantly and adequately to achieve discharge of the liquid (ink) with the particularly high response characteristics.

As the pulse driving signal, signals disclosed in U.S. Patent Nos. 4,463,359 and 4,345,262 are suitable. Note that further excellent printing can be performed by using the conditions described in U.S. Patent No. 4,313,124 of the invention which relates to the temperature rise rate of the heat acting surface.

As an arrangement of the printhead, in addition to the arrangement as a combination of discharge nozzles, liquid channels, and electrothermal transducers (linear liquid channels or right angle liquid channels) as disclosed in the above specifications, the arrangement using U.S. Patent Nos. 4,558,333 and 4,459,600, which disclose the arrangement having a heat acting portion arranged in a flexed region is also included in the present invention. In addition, the present invention can be effectively applied to an arrangement based on Japanese Patent Laid-Open Publication No. 59-123670 which discloses the arrangement using a slot common to a plurality of electrothermal transducers as a discharge portion of the electrothermal transducers, or Japanese Patent

Laid-Open No. 59-138461 Publication which discloses the arrangement having an opening for absorbing a pressure wave of heat energy in correspondence with a discharge portion.

5   In addition, an exchangeable chip type printhead which can be electrically connected to the apparatus main body and can receive ink from the apparatus main body upon being mounted on the apparatus main body can be employed as well as a cartridge type printhead in

10   which an ink tank is integrally arranged on the printhead itself as described in the above embodiments.

It is preferable to add recovery means for the printhead, preliminary auxiliary means and the like to the above-described construction of the printer of the

15   present invention since the printing operation can be further stabilized. Examples of such means include, for the printhead, capping means, cleaning means, pressurization or suction means, and preliminary heating means using electrothermal transducers, another

20   heating element, or a combination thereof. It is also effective for stable printing to provide a preliminary discharge mode which performs discharge independently of printing.

Furthermore, as a printing mode of the printer,

25   not only a printing mode using only a primary color such as black or the like, but also at least one of a multi-color mode using a plurality of different colors

- 26 -

or a full-color mode achieved by color mixing can be implemented in the printer either by using an integrated printhead or by combining a plurality of printheads.

5   Moreover, in each of the above-mentioned embodiments of the present invention, it is assumed that the ink is a liquid. Alternatively, the present invention may employ an ink which is solid at room temperature or less and softens or liquefies at room

10   temperature, or an ink which liquefies upon application of a use printing signal, since it is a general practice to perform temperature control of the ink itself within a range from 30°C to 70°C in the ink-jet system, so that the ink viscosity can fall within a

15   stable discharge range.

          In addition, in order to prevent a temperature rise caused by heat energy by positively utilizing it as energy for causing a change in state of the ink from a solid state to a liquid state, or to prevent

20   evaporation of the ink, an ink which is solid in a non-use state and liquefies upon heating may be used. In any case, an ink which liquefies upon application of heat energy according to a printing signal and is discharged in a liquid state, an ink which begins to

25   solidify when it reaches a printing medium, or the like, is applicable to the present invention. In the present

invention, the above-mentioned film boiling method is
most effective for the above-mentioned inks.

In addition, the ink-jet printer of the present
invention may be used in the form of a copying machine
5   combined with a reader and the like, or a facsimile
apparatus having a transmission/reception function in
addition to an image output terminal of an information
processing apparatus such as a computer.

The present invention can be applied to a system
10   constituted by a plurality of devices (e.g., a host
computer, an interface, a reader and a printer) or to
an apparatus comprising a single device (e.g., a copy
machine or a facsimile apparatus).

Further, the object of the present invention can
15   be also achieved by providing a storage medium (or
recording medium) storing software program code for
performing the aforesaid processes to a system or an
apparatus, reading the program code with a computer
(e.g., CPU, MPU) of the system or apparatus from the
20   storage medium, then executing the program. In this
case, the program code read from the storage medium
realizes the functions according to the embodiments,
and the storage medium storing the program code
constitutes the invention. Furthermore, besides
25   aforesaid functions according to the above embodiments
are realized by executing the program code which is
read by a computer, the present invention includes a

case where an OS (operating system) or the like working on the computer performs a part or entire processes in accordance with designations of the program code and realizes functions according to the above embodiments.

5   Furthermore, the present invention also includes a case where, after the program code read from the storage medium is written in a function expansion card which is inserted into the computer or in a memory provided in a function expansion unit which is

10   connected to the computer, CPU or the like contained in the function expansion card or unit performs a part or entire process in accordance with designations of the program code and realizes functions of the above embodiments.

15   As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the

20   appended claims.